CLAIMS

What is claimed is:

1. An at least partially translucent optical element for distributing light from a light source, the element comprising:

a hub member formed about a central axis, having an external surface between first and second ends and forming a recess within the first end that extends along the central axis substantially along a length of the hub member between the first and second ends for receiving the source, the external surface forming a lens for dispersing light directed thereat from within the recess out of the element; and

a reflecting member integral with and extending from the second end, the reflecting member including at least one external reflecting surface that reflects substantially all of the light directed into the reflecting member from within the recess back into the element.

2. The element of claim 1 wherein the reflecting member further includes at least one lateral surface disposed laterally of the central axis, the reflecting surface directing light toward and out of the element through the lateral surface.

3. The element of claim 2 wherein the hub forms a first receiving surface at the first end and wherein the at least one reflecting surface generally faces in a direction opposite the receiving surface.

4. The element of claim 3 wherein the reflecting surface is concavely conical having an apex on the central axis.

5. The element of claim 4 wherein the lateral surface is a substantially cylindrical surface formed about and parallel to the element axis.

6. The element of claim 5 wherein the lateral surface is substantially cylindrical and the hub has a mean diameter that is less than the diameter of the lateral surface.

7. The element of claim 3 wherein the external surface of the hub forms a fresnel lens for radially dispersing light directed thereat from within the recess.

8. The element of claim 7 wherein the fresnel lens includes a plurality of triangular prism elements arranged in a circular path concentric with the central axis.

9. The element of claim 7 wherein the light passing through the lateral surface is substantially perpendicular to the central axis.

10. The element of claim 2 wherein the lateral surface is a first lateral surface and is a first dimension from the central axis and wherein the element includes at least a second lateral surface, the second lateral surface substantially cylindrical, concentric with the central axis and a second dimension from the central axis, the second dimension less than the first dimension.

11. The element of claim 10 wherein the first lateral surface is closer to the reflecting surface than the second lateral surface.

12. The element of claim 2 wherein the lateral surface is a first lateral surface and the apparatus includes a plurality of lateral surfaces, each lateral surface defining a cylinder of constant radius about the central axis, each of the cylinders having a unique radius, the radius of each cylinder less than the radii of other cylinders relatively further away from the receiving surface.

13. The element of claim 12 wherein the element further includes a plurality of additional surfaces, one additional surface between each two adjacent lateral surfaces.

14. The element of claim 13 wherein the additional surfaces are substantially flat surfaces and are substantially perpendicular to adjacent lateral surfaces.

15. The element of claim 1 for use with other elements to form an assembly wherein the reflecting surface forms an alignment coupler for aligning the element with other assembly components and with respect to the central axis.

16. The element of claim 15 wherein the alignment coupler is an extending rib that is concentric with the central axis.

17. The element of claim 1 wherein the element is plastic.

18. The element of claim 1 further including an LED as the light source.

19. An apparatus comprising:

a substantially translucent element including a plurality of external surfaces including at least one light receiving surface for passing light from a source along a plurality of trajectories into the element, at least a subset of the element surfaces juxtaposed to reflect light received through the receiving surface internally and radially outwardly from a central axis and through at least one lateral surface out of the element;

a light source juxtaposed to emit light into the element through the receiving surface when energized;

a driving circuit that includes receiving apertures that define a pattern;

substantially rigid electrical leads coupled to the source and juxtaposed with respect to each other so that the leads define the same pattern as the receiving apertures such that the leads are receivable within the apertures.

20. The apparatus of claim 19 further including a heat sink member contacting the source.

21. The apparatus of claim 20 wherein the source is mounted to the sink member and wherein the apparatus further includes a support member, the sink member mounted to the support member.

22. The apparatus of claim 21 wherein the support member forms a recessed center and the sink is mounted within the recessed center.

23. The apparatus of claim 22 wherein the support member includes a side surface and forms channels for passing electrical leads.

24. The apparatus of claim 23 wherein the support member also includes a first surface facing the element and wherein the first surface forms channels for passing the electrical leads from the source to the channels formed by the side surface.

25. The apparatus of claim 24 wherein there are two electrical leads linked to the source and wherein the side surface forms more than two channels for receiving electrical leads.

26. The apparatus of claim 22 wherein the lateral surface is substantially cylindrical and is concentric with the central axis.

27. The apparatus of claim 26 wherein the electrical leads extend from the support member in a direction away from the element.

28. The apparatus of claim 27 wherein the leads extend radially further than the lateral surface from the central axis.

29. The apparatus of claim 28 wherein the support member includes first and second substantially oppositely facing surfaces, the sink member is mounted to a first surface and the second surface forms a support coupler, the element forming an element coupler, the support member and element couplers configured to cooperate and align the support member and the element concentrically.

30. The apparatus of claim 29 wherein the support coupler includes a recess and the element coupler includes a rib receivable within a support coupler recess.

31. The apparatus of claim 30 wherein the rib is substantially annular.

32. The apparatus of claim 19 wherein the receiving surface forms a recess for receiving the source and wherein the section of the source from which light emanates is substantially received within the recess.

33. The apparatus of claim 30 wherein the lateral surface is substantially cylindrical and is concentric with the central axis.

34. The apparatus of claim 19 wherein the source is an LED.

35. An apparatus comprising:

a base member;

a translucent cover member securable to the base member so that the base member and cover form a cavity;

driving circuitry mounted to the base member;

at least one optical module mounted within the cavity, the module including:

a substantially translucent element including a plurality of external surfaces including at least one light receiving surface for passing light from a source along a plurality of trajectories into the element, at least a subset of the element surfaces juxtaposed to reflect light received through the receiving surface internally and substantially radially outwardly from a central axis and through at least one lateral surface out of the element; and

a light source juxtaposed to emit light into the element through the receiving surface when energized.

36. The apparatus of claim 35 wherein the cover and the base member have at least partially facing surfaces and wherein the optical module components are juxtaposed within the cavity such that the at least partially facing surfaces clamp the module components together.

37. The apparatus of claim 35, wherein the cover member is sonically welded to the base member.

38. The apparatus of claim 35 wherein the optical module is a first optical module and wherein the apparatus further includes a plurality of optical modules mounted within the cavity.

39. The apparatus of claim 38 wherein the source of the first module generates greater light intensity than the source of the other modules.

40. The apparatus of claim 38 wherein the color of the light generated by the source in the first module is different than the colors of light generated by the other modules.

41. The apparatus of claim 38 wherein the plurality includes three.

42. The apparatus of claim 38 wherein the plurality of optical modules are stacked one on top of another within the cavity so that the central axis of the modules are concentrically aligned.

43. The apparatus of claim 42 wherein at least partially facing first and second surfaces of the cover and base member clamp the modules together within the cavity.

44. The apparatus of claim 42 wherein the optical modules are identically configured.

45. The apparatus of claim 42 wherein each optical module further includes a support member, a separate support member mounted between each two adjacent elements.

46. The apparatus of claim 45 wherein each module further includes a heat sink member, each support member forms a central recess, each sink member mounted within one of the central recesses, the source in each module mounted to one of the sink members.

47. The apparatus of claim 46 wherein each support member includes a first surface that forms the central recess, the apparatus further includes electrical leads linking each of the sources to the driving circuitry, the first surface of each support member forms channels for passing the electrical leads and wherein the channels are offset from each other at different radial angles about the central axis.

48. The apparatus of claim 46 wherein each support member includes first and second substantially oppositely facing surfaces, the sink member is mounted to a first surface and the second surface forms a support coupler, each element including a reflecting surface facing opposite the sink member within the same module, the reflecting surface forming an element coupler, each support coupler configured to cooperate with one of the element couplers to align the support member and the element concentrically, the support coupler of each support member juxtaposed between elements cooperating with the element coupler of an adjacent element to align the support member and the element concentrically.

49. The apparatus of claim 35 wherein the source is an LED.

50. An apparatus comprising:

a base member;

a translucent cover member securable to the base member so that the base member and cover form a cavity;

driving circuitry mounted to the base member;

a plurality of optical modules mounted within the cavity, each module including:

a substantially translucent element including a plurality of external surfaces including at least one light receiving surface for passing light from a source along a plurality of trajectories into the element, at least a subset of the element surfaces juxtaposed to reflect light received through the receiving surface internally and substantially radially outwardly from a central axis and through at least one lateral surface out of the element;

a light source juxtaposed to emit light into the element through the receiving surface when energized; and

electrical leads linking the source to the driving circuitry.

51. The apparatus of claim 50 wherein the modules are stacked together so that the central axis of the modules align.

52. The apparatus of claim 51 wherein the electrical leads extend laterally further than the lateral surfaces from the central axis and then extend substantially parallel to the central axis toward the driving circuitry.

53. The apparatus of claim 52 wherein each lead extends along a unique radial trajectory away from the central axis.

54. The apparatus of claim 53 wherein each radial trajectory is separated from the other radial trajectories by at least 5 degrees.

55. The apparatus of claim 50 wherein the plurality includes three.

56. The apparatus of claim 50 wherein each of the lateral surfaces is substantially cylindrical and is concentric with the central axis.

57. The apparatus of claim 56 wherein each of the lateral surfaces is a first lateral surface and each of the elements includes a plurality of lateral surfaces, each of the lateral surfaces is substantially cylindrical and centered on the central axis, each of the lateral surfaces on each element defining a different dimension with the central axis.

58. The apparatus of claim 57 wherein each receiving surface forms a recess for substantially receiving the light emitting portion of a source.

59. The apparatus of claim 50 wherein the housing and base member include at least partially facing first and second surfaces and, wherein, the modules are sandwiched between the first and second surfaces to maintain their relative juxtapositions.

60. The apparatus of claim 50 wherein each of the sources is an LED.

61. A method of assembling a modular lighting device comprising the steps of:

providing a plurality of optical modules, each module including a substantially translucent element including a plurality of external surfaces including at least one light receiving surface for passing light from a source along a plurality of trajectories into the element, at least a subset of the element surfaces juxtaposed to reflect light received through the receiving surface internally and substantially radially outwardly from a central axis and through at least one lateral surface out of the element, the element emitting a known quantum of light through the lateral surface when a light source of specific intensity is juxtaposed to emit light through the receiving surface and a light source of the specific intensity juxtaposed to emit light into the element through the receiving surface when energized;

identifying a desired output light intensity to be emitted from the lighting device;

selecting a quantity of the optical modules to achieve the desired output light intensity;

linking the selected quantity of modules to a driving circuit to provide power thereto; and

placing a translucent cover over the modules.

62. The method of claim 61 wherein the driving circuitry is mounted to a base member and wherein the method further includes the step of securing the cover to the base member.

63. The method of claim 62 wherein the step of mounting the cover to the base member includes hermetically sealing the cover to the base member.

64. The method of claim 63 wherein the step of sealing includes sonically welding the cover to the base member.

65. The method of claim 62 wherein step of linking the modules to the drive circuitry includes stacking the modules together so that the central axis of the modules are concentric.

66. The method of claim 65 further including the step of providing a different cover for each selectable number of modules wherein each cover forms a first surface that at least partially faces a second surface formed by the base member when mounted thereto and, wherein, the method further includes the step of sandwiching the modules between the first and second partially facing surfaces to maintain the relative juxtapositions of the device components.

67. The method of claim 61 wherein the step of providing a plurality of optical modules includes providing modules that each also include a heat sink member linked to the source to dissipate heat.

68. The method of claim 61 further including the step of arranging the optical modules so that each element is observable from every radial angle about the central axis of the elements.

69. The method of claim 68 wherein the sources are substantially identical, one module generates enough radially emitted light to meet an SAE classification 1 intensity requirement, two modules generates enough radially emitted light to meet an SAE classification 2 intensity requirement and three modules generates enough radially emitted light to meet an SAE classification 3 intensity requirement.

70. A method of assembling a modular lighting device comprising the steps of:

providing a plurality of optical modules, each module emitting a known quantum of light along trajectories substantially perpendicular to a central axis and through a lateral surface when power is provided thereto;

identifying a desired output light intensity to be emitted from the lighting device;

selecting a quantity of the optical modules to achieve the desired output light intensity;

stacking the selected modules with their central axis aligned; and

linking the modules to a power source to provide power thereto.

71. The method of claim 70 wherein the step of providing modules includes providing modules where each module includes a substantially translucent element including a plurality of external surfaces including at least one light receiving surface for passing light from a source along a plurality of trajectories into the element, at least a subset of the element surfaces juxtaposed to reflect light received through the receiving surface internally and radially outwardly from a central axis and through at least one lateral surface out of the element and a light source juxtaposed to emit light into the element through the receiving surface when energized.

72. The method of claim 70 further including the steps of providing a plurality of substantially transparent covers wherein each cover is configured to accommodate a different number of optical modules, selecting a cover to accommodate the selected quantity of optical modules and placing the cover over the stacked modules.

73. The method of claim 70 wherein each module has an axial dimension along the central axis, the method further including the steps of providing a cover for at least N stacked modules and spacers wherein at least a subset of the spacers have axial dimensions identical to the axial dimensions of the modules, the step of selecting a quantity of modules including selecting M modules where M is less than

N and the method further including stacking N-M spacers along with the selected modules and then placing the cover over the spacer and module stack.

74. A method of assembling a modular lighting device comprising the steps of:

providing a plurality of optical modules, each module emitting light along known trajectories;

selecting a quantity of the optical modules to achieve the desired lighting effect;

stacking the selected modules together in a pattern to achieve the desired lighting effect;

linking the modules to a power source to provide power thereto; and

providing a housing assembly about the stacked modules that compressively holds the modules together in the stacked configuration.

75. An apparatus comprising:

a plurality of light sources, each source generating light along trajectories that fan out about a central light axis; and

a mounting structure for mounting the light sources such that the light axis are parallel to a central axis that has an axis length dimension and such that the sources are adjacent different locations along the axis length dimension.

76. The apparatus of claim 75 wherein the light axis are arranged along the central axis.

77. The apparatus of claim 75 further including a plurality of light guide elements, one element for each source, each element positioned with respect to an associated source such that at least a portion of light from the source that enters the element is directed substantially radially away from the central axis.

78. The apparatus of claim 77 wherein each element directs substantially all of the light from an associated source substantially radially.

79. The apparatus of claim 78 wherein each element includes at least one reflective surface for internally reflecting light directed thereat along trajectories substantially perpendicular to the central axis.

80. The apparatus of claim 76 wherein each light source is an LED.

81. A method comprising the steps of:

providing a plurality of light sources, each source, when energized, generating light along trajectories that fan out about a central light axis;

mounting the light sources such that the light axis are parallel to a central axis that has an axis length dimension and such that the sources are adjacent different locations along the axis length dimension; and

linking the sources to a driving circuit to provide power thereto.

82. The method of claim 81 wherein the step of mounting includes mounting the sources so that the light axis are aligned along the central axis.

83. The method of claim 81 further including the steps of providing a plurality of light guide elements, one element for each source, positioning each element with respect to an associated source such that at least a portion of light from the source that enters the element is directed substantially radially away from the central axis.

84. The method of claim 82 wherein the step of providing elements includes providing elements that direct substantially all of the light from a source at a specific point with respect thereto substantially radially away form the central axis and wherein the step of positioning each element includes positioning the element so that the associated source is at the specific point with respect thereto.

85. A strobe light comprising:

a plurality of LEDs, each LED generating light along trajectories that fan out about a central LED axis;

a support structure for mounting the LEDs such that the LED axis are aligned along a central axis;

a driving circuit for driving the LEDs, the driving circuit linked to each LED to provide power thereto; and

a housing assembly including a base member and a cover member that together form a cavity, the LEDs and support structure mounted within the cavity.

86. +The light of claim 85 further including a plurality of light guide elements, one element for each LED, each element positioned with respect to an associated LED such that substantially all of light from the LED that enters the element exits the element along trajectories that are substantially radially away from the central axis.